# LED CUBE & DUBSTEP SYNTHESIZER

ECE 405 – Senior Design III

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Document prepared by
Tyson Morlock
Aaron Aaberg
Jared Gratzek
Dane Swartz

Group Advisor: Professor Mark Schroeder, PhD

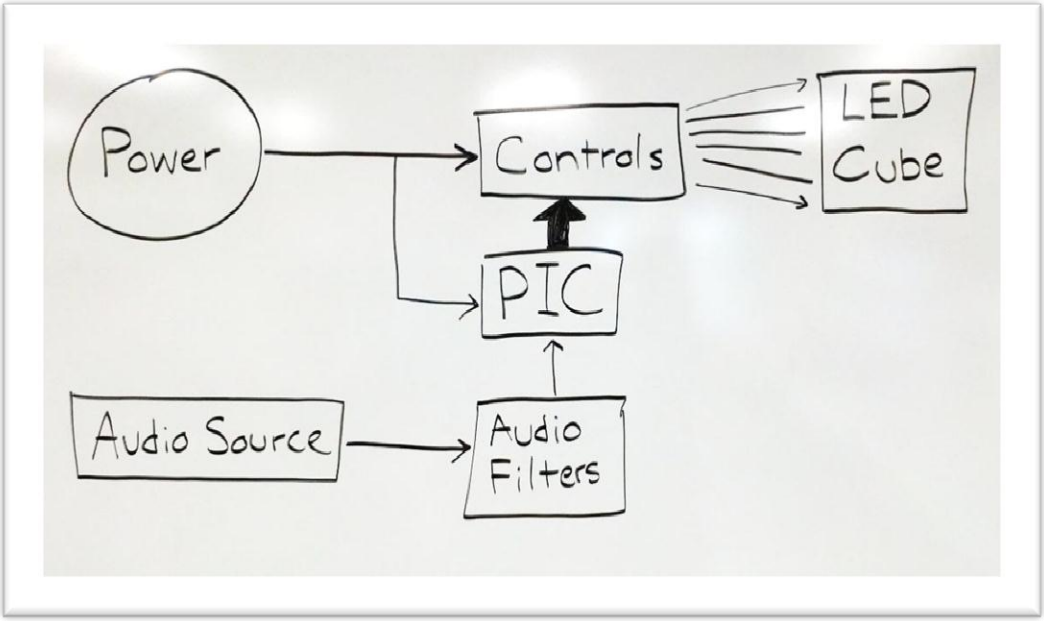
# LED CUBE

Aaron Aaberg - Jared Gratzek - Dane Swartz

## Brief Description:

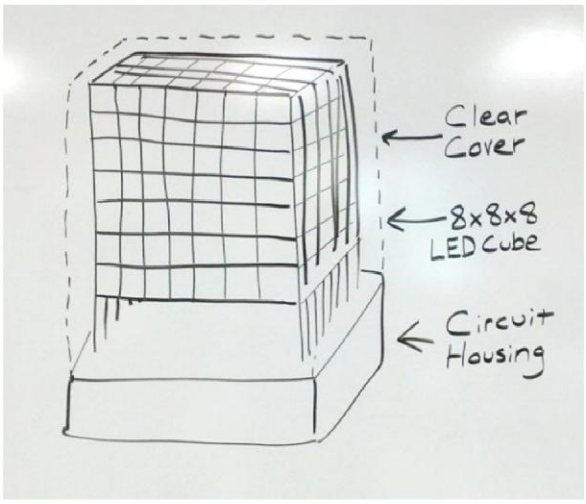
Back in the 70's there was a novel possession found in almost every best room, this glorious device was the Lava Lamp. This object has had a great impact on pop culture ever since. Fast forward 40 years and Lava Lamps have essentially gone extinct. Now is the time to revive the idea of this eye pleasing lamp and update it with technology from the 21st century. We proudly present the LED Cube.

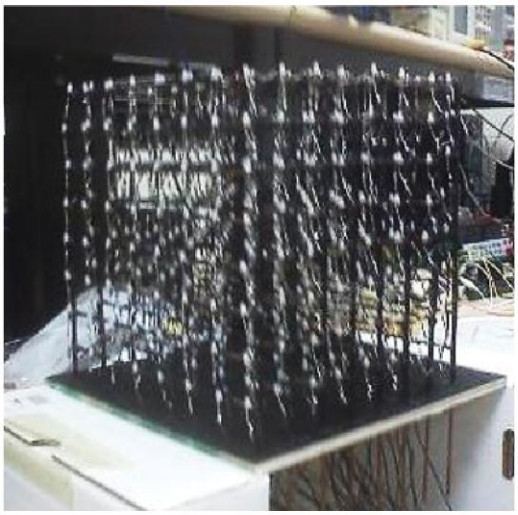
1. This device will consist of 512 LEDs formed in an 8x8x8 cube.
2. The LED cube will be assembled using a copper frame. The LEDs will be directly soldered to copper bars which will be fastened together to forming eight layers. These eight layers will be uniformly painted black and assembled identically. Arranging the separate layers together will lead to the 8x8x8 cube.
3. The Cathode post – short leg – will be soldered to the copper bar which will be grounded. The Anode post – long leg – will be power. This scheme will be as followed: columns=power, rows=grounded.
4. The housing for the LED cube will be contained inside of a clear plexiglass case.
5. All resulting circuitry will be out of sight, contained inside of a housing.
6. LEDs can be turned on separately and controlled individually.
7. The cube will be able to response to audio.
8. The LED cube will receive a signal through a 3.5mm stereo audio jack, allowing for multiple source devices (MP3 player, dubstep synthesizer, CD player, etc.).
9. If the device is turned on and no audio signal is present, the LED cube will go into a preprogrammed effect mode.




## Diagram:

The above diagram shows the audio source's signal (MP3 player, CD player or dubstep synthesizer) will be fed into the device's audio filters. Here the audio will be managed and passed to the PIC for processing. Depending on the data, the PIC will control the LED cube through our control circuitry.



The image to the left shows the layout of the device's main physical aspects; the 8x8x8 LED cube, the base which contains all the circuitry and the clear plexiglass cover which will safeguard our investment.

## LED Cube Timeline:

CUBE ASSEMBLY (Summer → 09/06/12)
During this phase our task is to assemble the general LED cube which consists of 512 LEDs attached to a copper frame.

CREATE CASE (09/06/12 → 09/13/12)
To protect the LED cube from being damaged, we will build a plexiglass case.

PIC DESIGN/BUILD (09/06/12 → 10/18/12)
The microprocessor board will be designed to run the controlling system for the device.

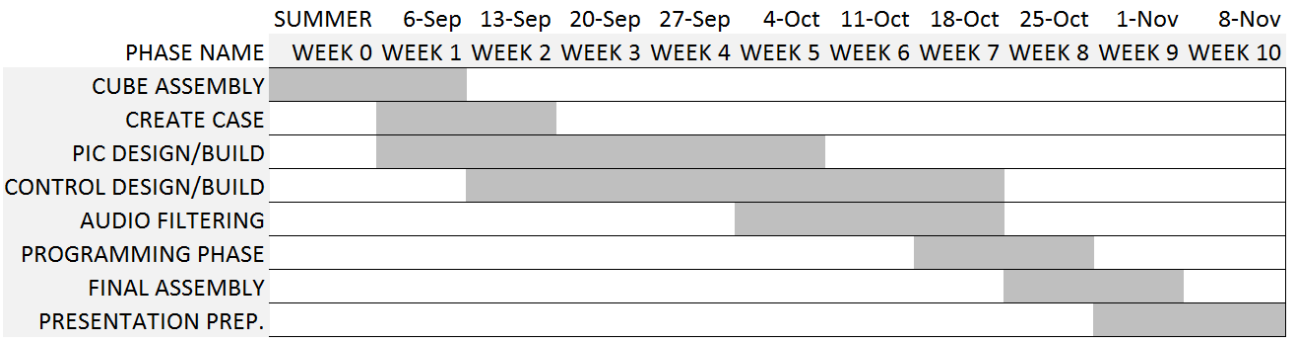
CONTROL DESIGN/BUILD (09/13/12 → 10/18/12)
Designed alongside the processor, the controlling circuitry will power the LEDS.

AUDIO FILTERING (10/04/12 → 10/18/12)
We will be focusing on pairing the audio filtering system with the microprocessor to analyze the data from the input signal.

PROGRAMMING PHASE (10/18/12 → 10/25/10)
With all required circuitry completed to run the LED cube, we will now focus on programming the complete system.

FINAL ASSEMBLY (10/25/12 → 11/01/12)
This phase will be used to condense all circuitry so it will fit into the housing.

PRESENTATION PREPERATION (11/01/12 → Demo Day)
We will be preparing a presentation to demonstrate our senior design project.



# DUBSTEP SYNTHESIZER

Tyson Morlock

## Brief Description:

Around the start of this millennium a new genre of music started to reveal itself called dubstep. The style is easily recognizable by its signature "wobble effect" on the music. It was started in London, England as a new form of dance music for their night clubs but the music gained quick popularity and began to spread around the world like a wildfire. A little over decade after its birth, dubstep is now the fastest growing genre of music. This style of music has always been created through various different software programs until now. Our project, called the Dubstep Synthesizer, entails creating a standalone electronic device with different effects to create that famous dubstep sound live without any software.

1. The device will have will have an LFO to create the low frequency dubstep sound.
2. The LFO will be able to create three different waves: sinusoidal, triangle, and square.
3. The LFO will be able to switch between these waves and change their frequency instantaneously.
4. The dubstep will have summing circuit in place to combine the LFO signal with an audio source (IPod, MP3 player, electronic keyboard, etc.).
5. The input from the audio source will first go through a feedback filter to ensure the source device will not be wrecked.
6. The summing circuit will output its signal to a power speaker and the LED cube. The speaker will be powered from a wall outlet and contain its own amplifier. The LED cube device will process the signal and play in sync with the Dubstep/Audio signal.
7. The two power supplies for the circuit, $V_{DD}$ and $V_{SS}$, will be created from a pair of voltage regulators. The first will be a positive buck regulator to create $V_{DD}$. The second will be a positive to negative

buck regulator to create $V_{SS}$. The input will come from a wall transformer/rectifier.

8. The device will be created professionally on a PCB and be enclosed into a case.
9. The enclosure will have two 3.5mm audio ports and a port for the power supply. The 3.5mm audio ports will consist of an input for the audio source and an output for the LED cube and power speaker.
10. The enclosure will also have a power switch and controls for the LFO oscillating frequency and for switching between the three LFO waveforms.

## Dubstep Synthesizer Timeline:

9/10/2012: Successfully have the summing circuit capable of adding together the LFO signal with an audio source

9/14/2012: Incorporate a keyboard as an audio input for the signal to be summed with the LFO

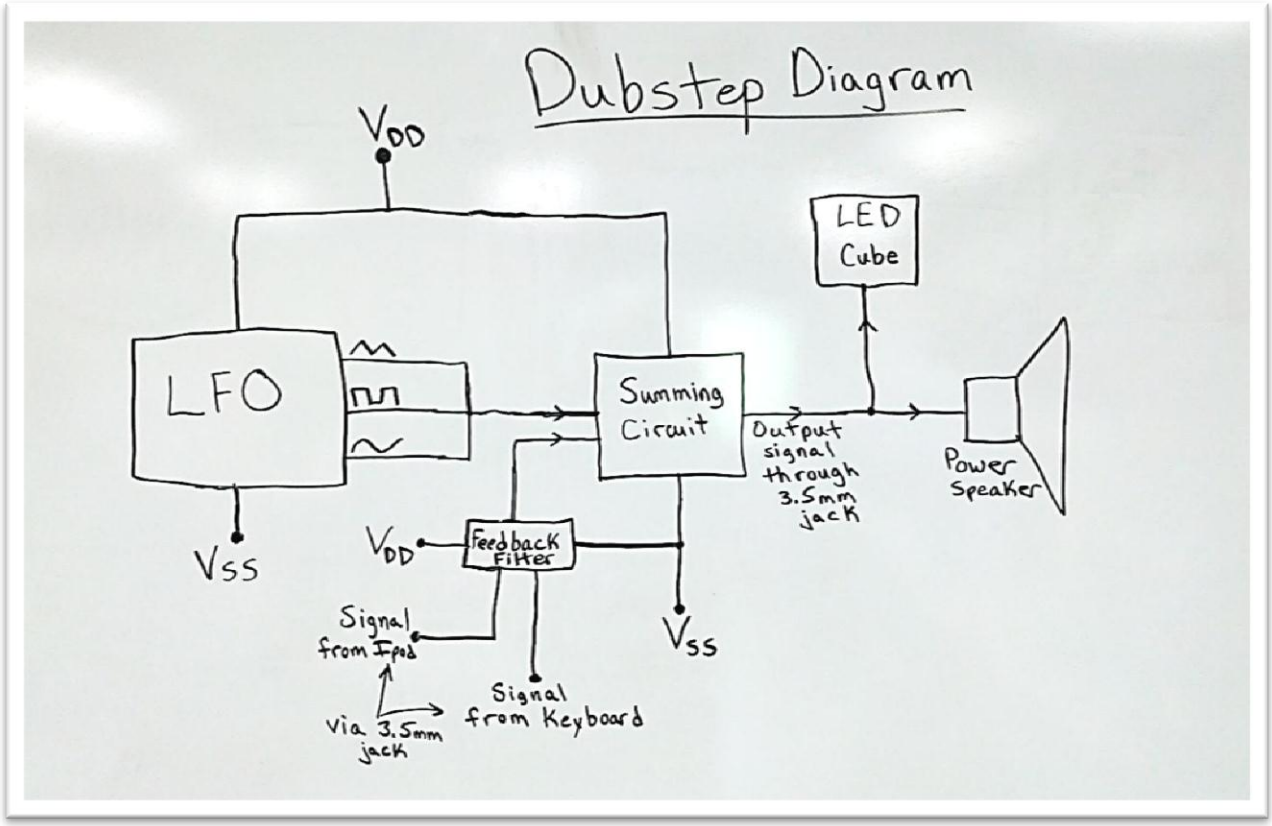
9/24/2012: Create the circuitry for the voltage regulators and add the PIC to the circuit to more accurately control oscillating speed

9/28/2012: Prototype design for PCB prepared

10/22/2012: Have final design completed and created on a PCB

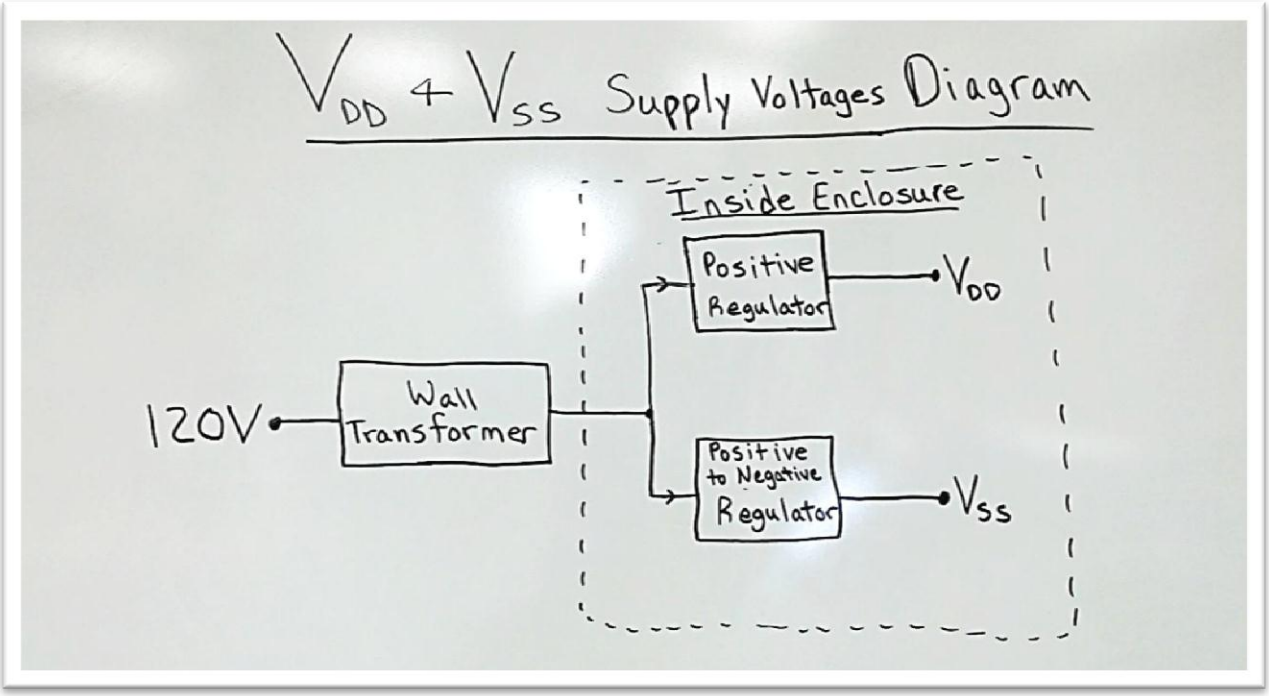
10/29/2012: Have an enclosure for final product so that it looks professional and clean

11/16/2012: Be ready for Demo Days, etc……




## Diagram:

The image above shows the block diagram of what will be inside of the final enclosure besides the speaker and LED cube of course. The circuitry will be supplied with a positive and negative voltage so the output is capable of creating the entire signal wave. The LFO will send the three different low frequency waveforms into the summing circuit to combine with the signal coming from the audio source. The music device is protected by the feedback filter so no current will be sent back into the device. The output of the summing circuit will head to the power speaker as well as the LED cube for signal processing. The power speaker runs off a 120V wall outlet.




## Diagram 2:

This picture shows a block diagram of the power source for the Dubstep Synthesizer. We decided to use a wall transformer as the power source for the device. This transformer will output into two voltage regulators. One will output $V_{DD}$ and the other will output $V_{SS}$. The regulators will be within the enclosure.

## Budget (updates shaded):

| Component | Estimated | Price | Total |
|---|---|---|---|
| 100 LEDS | $21 | Free | Free |
| 500 LEDS | $250 | $40 | $40 |
| Mounting Supplies | $20 | $20 | $20 |
| Audio Processor | $150 | $150 | $150 |
| 3.5mm Audio Jack | $5 | $5 | $3 |
| Block of Wood | Free | Free | Free |
| Electrical Parts | $50 | $50 | $50 |
| Housing | $25 | $25 | $25 |
| MP3 Player | $15 | $15 | $15 |
| Keyboard (Piano) | $200 | Free | Free |
| Speaker | $40 | $40 | $40 |
| Outsource PCB | $60 | $60 | $60 |
| Super Glue | $4 | $4 | $4 |
| Rubber Cement | $5 | Free | Free |
| Spray Paint | $4 | $4 | $4 |
| PIC Processor Components | $99 | Free | Free |
| Audio Splitter | $10 | Free | Free |

~~**Old Total: $500**~~

**New Total: $401**

## Dubstep Synthesizer Budget Breakdown:

Pic Processor (Retail: $99) – FREE

- Used to drive the Square waves throughout the Design so that it will control the oscillation
- Display will be used to display BPM (Beats Per Minute)

Keyboard (Retail: $200) – FREE

- This will input audio signal (any note played) into the Dubstep Modulator

- Also have to option to modulate different notes and sounds through the keyboard
- Will add user functionality so that it can be played as a type of "Instrument" or "Effects Processor"

Circuitry Components (Retail: $50) - $50 of $150

- Different kinds of amps, Potentiometers, Filter chip, possible Effects chip, a couple LEDs
- This will be used for the actual circuitry when producing and summing audio signals with the Low Frequency Oscillator to produce that Dubstep Tone

Printed Circuit Board (Retail: $30) - $30 of $60

- Will build a prototype, cheaper one and have a final one produced professionally
- This will give a professional and clean look to the design

Auxiliary Cable (Retail: $30) – FREE

- Will transmit the audio signal from keyboard to Dubstep Synthesizer and another one will transmit from modulator to a powered speaker

By shopping smart and manufacturing our own parts we are well under our previous budget from Design 2. Provided we conclude the design phase on time and no hardware breaks, we can use this money to buy tools or accessories that may give the product a more finished look.

## Conclusion:

Not much can be expected after the first week of Design 3. This document is an overview of how we plan to use the remaining time in Design 3 to continue developing engineering skills, project management skills and provide a working project based on concepts taken from Design 2.